University at Albany, SUNY

College of Engineering and Applied Sciences, Computer Science

ICEN/ICSI-210: Discrete Structures

Spring 2019

Homework Set 6

Chengjiang Long

Assigned Date: Mar 4, 2019 (Monday).
Due Date: Mar 11, 2019 (Monday), 11:59 PM.
Collaboration Policy. Homeworks will be done individually: each student must hand in their own answers. Use of partial or entire solutions obtained from others or online is strictly prohibited.
Late Policy. If urgent or unusual circumstances prohibit you from submitting a homework assignment in time, please e-mail the instructor explaining the situation to get exempt from late penalty. Otherwise, any late submissions without consent from the instructor will result in exponential penalty – late for one day loses 25%, two days loses 50%, and so on and so forth. **Those submissions $\geq$ 3 hours after the deadline will be considered as "late submission" with no exemption.**
Submission Format. Electronic submission as a PDF file to blackboard is mandatory.

- You can write your solution in Word and save it as a PDF file.
- You also can write it on any physical papers and scan them to a PDF file.
- If you don't have condition to scan, you still can take pictures by your smart phone and convert images to a PDF file by the online tool (https://imagetopdf.com).
- If you have multiple PDF files, please combine them to a PDF file by the online tool (https://www.pdfmerge.com) or (https://www.ilovepdf.com/merge_pdf).

Problem 1: Integers and Division (15 points) What are the quotient and remainder when
(a) 777 is divided by 21?
(b) -123 is divided by 19?
(c) -2002 is divided by 87?
(d) 0 is divided by 17?

(e) 1,234,567 is divided by 1001?

Problem 2: Modular Arithmetic (35 points) Find each of these values:

(a) $(177 \bmod 31 + 270 \bmod 31) \bmod 31$

(b) $(177 \bmod 31 \times 270 \bmod 31) \bmod 31$

(c) $(-133 \bmod 23 + 261 \bmod 23) \bmod 23$

(d) $(976 \bmod 32)^3 \bmod 15$

(e) $(49 \bmod 17)^2 \bmod 11$

(f) $(193 \bmod 23)^2 \bmod 31$

(g) $(893 \bmod 79)^4 \bmod 26$

Problem 3: Integer Representations (30 points)

(a) [2 points] Convert the decimal expansion 100632 to a binary expansion.

(b) [2 points] Convert the binary expansion $(110100100010000)_2$ to decimal expansion.

(c) [2 points] Convert the octal expansion $2417)_8$ to a binary expansion.

(d) [2 points] Convert the binary expansion $(101010101010101)_2$ s to an octal expansion.

(e) [2 points] Convert $(BADFACED)_{16}$ from its hexadecimal expansion to its binary expansion.

(f) [2 points] Convert $(1100001100011)_2$ from its binary expansion to its hexadecimal expansion.

Problem 4: Modular Exponentiation (20 points) Use Modular Exponentiation Algorithm to find $123^{1001} \bmod 101$.

[Optional] Extra Points (20 points)

(a) [8 points] Which memory locations are assigned by the hashing function h(k) = k mod 97 to the records of insurance company customers with these Social Security number 987255335 and 501338753?

The United States Postal Service (USPS) sells money orders identified by an 11-digit number $x_1x_2 \ldots x_{11}$. The first ten digits identify the money order; x11 is a check digit that satisfies $x_{11} = x_1 + x_2 + \ldots + x_{10} \bmod 9$.

(b) [6 points] Find the check digit for the USPS money orders that have identification number that start with these ten digits 3289744134.

(c) [6 points] Determine whether 66606631178 is a valid USPS money order identification number.